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ABSTRACT

Issues pertaining to thinking skills are discussed in an attempt to clarify what thinking skills are and their components, how they function and how they can be developed in the teaching-learning environment. Chapter 1 reviews the definitions of thinking skills. These definitions are selected from the current literature on education and psychology. Chapter 2 provides a national perspective on the implementation of thinking skills programs. Chapter 3 describes a variety of programs in Oregon elementary and middle schools. Three commercial thinking skills programs are described in chapter 4. Chapter 5 discusses some criteria that can be used when designing or selecting thinking skills programs. The bulletin concludes that the multidimensionality involved in the teaching of thinking skills and the unidimensionality entailed in defining and measuring them through standardized tests run counter to one another. Students can learn to apply their thinking skills in the real world if textbook problems sufficiently resemble real-world problems; that is, textbook problems should be contextualized. (SI)

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UNDERSTANDING THINKING SKILLS

Bijaya K. Shrestha

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Preface

Thinking skills have become a hotly debated topic. The impetus came from the wave of new research reports and other publications that suggest thinking skills can help prepare students to make the transition from school to work in the "information age" society.

This Bulletin, *Understanding Thinking Skills,* explores the issues surrounding this topic and transmits two key findings: thinking skills can help students cope with the fast-approaching twenty-first century, and these skills are best taught jointly with substantive content.

The Bulletin reviews and summarizes the current research on thinking skills drawn from education and psychology. It reports on the characteristics of effective thinking skills programs in schools, both at the national and local levels. The experience reported in these pages corroborates the claim of thinking skills theoreticians that mental techniques and content matter are best taught together.

Bijaya K. Shrestha, a member of the OSSC staff, received his master's degrees in public affairs and international studies from the University of Oregon. At present, he is a doctoral student in the Division of Educational Policy and Management at the University of Oregon.

Philip K. Piele
Executive Secretary

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Introduction

In Fairbanks, Alaska, ninety-six children attending six public kindergarten schools participated in an experimental thinking skills program in 1983. The results of the program suggest that children learn most effectively when teachers adopt an eclectic approach in responding to the needs of their students (Ruth Rawl and Frances O'Tuel 1983). This program reflects educators' continuing interest in thinking skills, sparked by the documented shortcomings in student performance throughout the nation, beginning in 1981 (Richard Stiggins, Maggie Griswold, Karen Wikelund 1989).

This thinking skills program, one of many in school districts throughout the nation, represents an attempt to come to grips with the issue of student performance. Because student performance is directly related to thinking skills instruction, thinking skills have become one of the most important issues being debated today.

Three reasons may help to explain why this debate has caught the public eye. First, influential educational reports in the first half of the 1980s, beginning with *A Nation at Risk* (1983), underscored the need to impart necessary skills to students and to prepare them to enter adult life. Second, the writings of prominent futurists linking the outputs of education to the inputs of industry caused educators to think seriously about thinking skills as a means to improve education. John Naisbitt's *Megatrends* (1984) may have begun to influence educators' ideas of incorporating thinking skills into classroom instruction. Third, the scholarly output from the philanthropic organizations ties education to the future of the American economy even as it becomes increasingly interlocked into the international economy.

Most of the published work from these organizations stresses the importance of thinking skills in one form or the other. In *The Report of the Task Force of Teaching as a Profession* (1986), the Carnegie Forum on Education and the Economy addressed this issue when it described capable students as those who have the need and the ability to learn all the time. When they come to the workplace, they do not need to know everything they will ever know. But they do need to know how to figure out what they need to know, where to get it, and how to make meaning out of it.

This issue of the *OSSC Bulletin* focuses on some of the important issues pertaining to thinking skills. It attempts to clarify what thinking skills are and their components, how they function, and how they can be developed in the teaching-learning environment.

Chapter 1 reviews some of the definitions of thinking skills. These definitions are selected from the current literature on education and psychology. Chapter 2 provides a national perspective on the implementation of thinking skills programs. Chapter 3 describes a variety of programs in Oregon elementary and middle schools. Three commercial thinking skills programs are described in chapter 4. Chapter 5 discusses some criteria that can be used when designing or selecting thinking skills programs. The importance of teaching thinking skills cannot be overemphasized because they play an important role in preparing students for the fast-approaching twenty-first century.

This issue of the *OSSC Bulletin* would lack some of its insights were it not for the help and cooperation extended to me by many educators and educational administrators. I thank them for taking the time to speak with me.

Chapter 1

Thinking Skills Defined

At first consideration, thinking skills may seem to be merely a new technique to market the ready-made educational packages designed to respond to the call for excellence in schools (Chester Finn, Jr. 1988). Teachers and administrators may be aware of the many different guises used by publishers to promote their merchandise in the schools. Indeed, these materials may not always significantly contribute to their students' learning and thinking abilities (Carl Bereiter 1984).

In addition to being wary of hucksters, some teachers and administrators may question even the need for a focus on thinking skills. Does not their daily work directly or indirectly stimulate their students' thinking and therefore contribute to excellence in the schools? For these reasons, some practitioners may be skeptical of thinking skills and dismiss the issue as merely being old wine in new bottles.

Actually, the perception of thinking skills as packaged snake oil has less to do with their importance than with identifying *what* they are and *how* to teach them. As indicated in the Introduction of this Bulletin, educators understand the connection between student performance and thinking skills. The real issue is the many different and often conflicting definitions of thinking skills in educational reports. Because of these many definitions, educators can despair of ever getting a firm handle on thinking skills.

Defining thinking skills has always been difficult because of the lack of agreement over their precise interpretation among educational scholars and practitioners. Drawing upon the current research in thinking skills, this chapter first presents some of the different ways of viewing thinking skills. Second, it presents a practical guide to thinking skills. And finally, the chapter concludes by promoting an eclectic approach to thinking skills.

Definitions of Thinking Skills

Before teachers can do a better job of teaching thinking skills, they must first clearly define them. Barry Beyer (1984) presents one scheme for

defining thinking skills. Beyer divides all thinking skills into two categories: problem-solving skills and decision-making skills. He breaks down the problem-solving skills category into five steps:

1. identifying and clarifying a problem
2. hypothesizing solutions to the problem
3. testing the various alternative solutions
4. choosing the appropriate solution
5. appying the solution

Beyer contrasts problem-solving skills with decision-making skills by proposing that the latter consist of six different steps:

1. stating the desired goal or condition
2. stating the obstacles to realizing this goal or objective
3. identifying the alternatives available for overcoming each obstacle
4. examining the alternatives in terms of the resources needed to carry them out, the costs involved, and the constraints inherent in their use
5. ranking the alternatives in terms of their probable consequences
6. choosing the best alternative

Beyer's classification of thinking skills builds upon the work of Benjamin Bloom, who is best known for his *Taxonomy of Educational Objectives*. Bloom's list includes six thinking skills: recall, comprehension, application, analysis, synthesis, and evaluation. Several thinking skills researchers, including Beyer, have taken Bloom's work as a starting point.

David Perkins's (1984) work in creativity focuses on some of the gaps present in the application, analysis, and synthesis components of Bloom's list of thinking skills. According to Perkins, creativity is an aspect of thinking skills. He defines *creativity* as a pattern of thought that demonstrates itself in a person's output, which is consistently original and appropriate for the relevant context. Perkins attributes these outputs to the following six principles of creative thinking:

1. Creative thinking requires both intellectual and practical criteria.
2. Creative thinking depends on both attention and purpose.
3. Creative thinking depends on the ability to break down ideas and rearrange them in different patterns as well as awareness of the ideas themselves.
4. Creative thinking is the result of unstinting and continuous work.
5. Creative thinking is the product of taking a self-critical stance to one's work as well as seeking criticism for improvement.
6. Creative thinking depends upon both intrinsic and extrinsic motivation.

Perkins's principles of creative thinking may be summarized as inductive and deductive thinking. Inductive thinking can be described as the ability to generalize after studying many facts. Deductive thinking may be defined as the ability to select certain facts from many others to fit a generalization.

Raymond Nickerson's (1984) work ties in with Perkins's list of thinking skills. Nickerson writes that thinking skills cannot be separated from substantive content. Thinking skills make up both inductive and deductive thinking. Both inductive and deductive thinking are context-dependent as is demonstrated by our thought processes, states Nickerson.

To do any thinking, one must think *about* something. The more one knows, the more effective one's thinking can be. Much knowledge may not guarantee effective thinking, but lack of knowledge will effectively prohibit it. Nickerson concludes that knowledge and thinking skills are "interdependent and mutually reinforcing; attempting to develop one without the other is like trying to make cloth with only one side."

Robert Sternberg (1988) captures this interdependence between thinking skills and substantive knowledge in his triarchic theory of thinking skills. He defines thinking skills as components of human cognition and describes them as muscles of the mind. He refers to these muscles, or components, as the legislative, judicial, and executive intellectual learning styles. Each learning style has distinctive characteristics with well-defined tendencies. A student may exhibit a strong preference for one particular intellectual learning style, but all three intellectual learning styles are usually present to some degree in all students. The following section describes the three intellectual styles and presents cases to illustrate each of the theoretical models.

The Legislative Style

The legislative intellectual learning style is characterized by creating, formulating, and designing problems. Individuals who prefer this intellectual style work best at their own pace and are challenged by unstructured problems and opportunities to engage in creative problem-solving techniques. They define what they want to learn and the rules of learning.

Students who favor this approach work well in a highly interactive learning environment. They relish complexity and learn best through discussions with teachers and classmates. They appreciate the intrinsic value of ideas and prefer to define for themselves the body of knowledge they are expected to master. Students with this intellectual learning style tend to excel in the arts and the humanities.

The Executive Style

The executive intellectual learning style lends itself to a prescribed method in implementing plans. Individuals who rely heavily on this style prefer structured problems and structured problem-solving techniques that

have been defined in advance. They work well in a learning environment in which the teacher takes the initiative and sets the tone of the class. Students with this learning style prefer applying clearly defined rules to preexisting problems. They tend to excel in the natural sciences and mathematics.

The Judicial Style

The judicial intellectual learning style is characterized by an ability to think critically, make judgments, and evaluate. Individuals who gravitate toward this learning style are in their element in analytical work, writing criticisms of others' works, and evaluating programs. Students with this intellectual learning style often have a predilection for the social sciences.

Students use all three intellectual learning styles, but they tend to specialize in one particular style. One person, for example, may be strong in the legislative style, make moderate use of the executive style, and use the judicial style infrequently. Another example can be a person who is strongly executive, mildly judicial, and weakly legislative. A final example can be that of a person who uses all three intellectual learning styles fairly equally. The three intellectual learning styles are components of thinking skills, which in turn are components of cognition. Therefore, intellectual learning styles can be viewed as metacomponents of cognition.

Individuals differ in both the direction and degree of specialization of intellectual learning styles. Different students depend on different intellectual learning styles to respond to their school curriculum and environment. If intellectual learning styles are thought of as the muscles of the mind, we can say that different students develop different muscles by exercising them, guided by other contextual differences. These contextual differences may be better understood within the framework of three dominant models of cognitive and development theory. The three models can be described as the Piagetian development model, the information processing model, and the psychometric model.

Richard Wagner and Robert Sternberg (1984) take the position that the three models are complementary and may even overlap. The Piagetian model provides an explanation based on biological maturation, environment, and society. It is the most context-dependent of the three models and may have some similarities with Sternberg's legislative intellectual learning style.

The information-processing model focuses on within-subject processes of information representation, storage, and manipulation. This model is less context-dependent than the Piagetian model and may have some similarities with the executive intellectual learning style.

The psychometric model is mainly based on factor analysis and provides an explanation of the hierarchical and correlational structure of various intellectual abilities. This model may be the least context-dependent and may be somewhat analogous to the judicial intellectual learning style.

The Practical Value of Thinking Skills

An explicit thread running through the various definitions of thinking skills surveyed above is the connection between thinking skills and human cognition. At times, in fact, it becomes difficult to differentiate thinking skills from human cognition.

The theories of psychology tell us that all the thinking skills taken together make up human cognition. While there is much debate about the precise number of thinking skills, one possible way to resolve this controversy would be to follow the path taken by Richard Stiggins and his colleagues (1989) at the Northwest Regional Educational Laboratory (NWREL) to analyze the components of critical thinking. These authors divide thinking skills by function. Starting with the premise that thinking skills include all the workings of the mind, they call these workings "processes." These processes are aimed at producing two purposes: (1) solving problems and making decisions and (2) creating ideas or knowledge that did not exist. The first process may be defined as *critical thinking* and the second as *creative thinking*.

Critical Thinking

According to Stiggins and his colleagues, critical thinking consists of five skills:

1. *Recall.* Most school tasks require that students recognize or remember facts, definitions, concepts, rules, or principles. Recall questions require students to repeat verbatim or paraphrase information. To recall information, students need to rehearse or practice it, then to associate it with other related concepts.
2. *Analysis.* In this operation, students divide a whole into component elements; or they search for a cause and effect relationship. Part/whole relationships and cause/effect relationships characterize knowledge and hence are essential for mastering or comprehending bodies of information.
3. *Comprehension.* Here students are asked to recognize and explain similarities and differences. Comparisons may be simple, requiring attention to only one or two attributes of information; or they may be complex, requiring identification and differentiation of many attributes of facts.
4. *Inference.* Both deductive and inductive reasoning may be required to arrive at inferences. In deductive tasks, students are given a generalization and asked to recognize or explain the evidence that relates to it. In inductive tasks, students are given the evidence (or details) and asked to come up with the generalization.
5. *Evaluation.* This skill requires students to judge quality,

credibility, worth, or practicality. To help them make such judgment, students are asked to set up criteria (or standards) and then explain how these criteria are or are not met.

Creative Thinking

Stiggins and his colleagues acknowledge that there may be more than one definition of creative thinking. Creative thinking depends on many different circumstances and may not be easily summarized in a tidy definition. However, they list the following characteristics that may help us to recognize it:

1. Creative thinking requires self-confidence, a trust in one's own standards and criteria. Creative thinkers look inwardly to themselves rather than outwardly to others for judgment and approval. Quite frequently, the creative thinker wants to work alone, so as to have a buffer zone from customary norms and practices.
2. Creative thinking is "flexible," "divergent," or involves seeing things laterally, from all sides. In other words, creative thinking requires seeing things from different perspectives. Edward deBono (1984) calls this ability to see things laterally "creative thinking first-stage thinking." First-stage thinking deals with the *perception* of ideas as opposed to their *internal* logic. It incorporates a self-organizing and active information system. This information system relies on prearranged patterns stored in the brain to respond and adapt to changing circumstances.
3. Creative thinking permits the subconscious to come to the surface. There are many examples in history testifying to the role of the subconscious in creative work: Coleridge's sudden awakening to write the magic fragment starting "In Xanadu did Kublai Kahn ..."; Mendelev's work of seeing the periodic table of elements in a dream; Kekule's vision in broad daylight of molecular structure. However, the bulk of scientific evidence indicates the subconscious will assist in creative work only if the conscious mind is already actively working on the problem. The creative thinker doesn't simply sit back and wait passively for solutions or products to materialize. Hard, conscious work, plus the workings of the subconscious, often produce brilliant results.

Robert Marzano and his colleagues (1988) designed a method to put the theories of thinking skills to practice. In their monograph *The Dimensions of Thinking*, they list six primary skills and twenty-one subskills that may contain all the elements of thinking skills explained above:

1. *Representing*
   1.1. Changing the form but not the value of the information
   1.2. Assigning a name or label to the information collected

1.3. Representing information via a logic, mathematical, music, or other type of symbol

1.4. Outlining or highlighting information

1.5. Designing a model of the information

2. *Comparing and contrasting*

2.1. Identifying similarities within the information gathered

2.2. Identifying differences within the information gathered

3. *Grouping and classifying*

3.1. Grouping and classifying information by common characteristics

3.2. Grouping and classifying by preassigned categories

3.3. Grouping and classifying using other criteria

4. *Ordering*

4.1. Ordering information by sequence or position

4.2. Ordering information by intensity

4.3. Ordering information by duration

4.4. Ordering information by other criteria

5. *Arranging*

5.1. Arranging information in tables

5.2. Arranging information in graphs

5.3. Arranging information in diagrams or flow charts

5.4. Arranging information in other formats or frames

6. *Storing*

6.1. Visualizing information in various ways

6.2. Associating information with various memory clues

6.3. Using structured memory devices

Conclusion

As this chapter demonstrates, there is no one best way to view thinking skills. The views of researchers surveyed in this chapter may not be identical, but they complement one another. Taken together, they help us understand thinking skills. Broadly speaking, the connection between mental techniques and substantive knowledge is the common thread running through the various definitions of thinking skills.

Whether thinking skills are processes or discrete operations, they can be thought of as having three parts. First, they may be a set of procedures that one undertakes to apply the abstract skills to concrete situations. Sec-

ond, they consist of rules that guide and direct our use of these operations. And finally, they include knowledge that helps us select the appropriate rules necessary to practice the skills.

These three parts capture the different interpretations of thinking skills. Educators and school leaders may find it profitable to adopt an eclectic approach, incorporating some of the ideas and strategies presented in this chapter, guided by the specific needs of the classroom and school district. Because of the differences in students, school environment, and home environment, a rigidly defined approach to thinking skills is not realistic.

Chapter 2

AASA's Survey of Thinking Skills Programs

What are some of the characteristics of effective thinking skills programs? How do schools and school districts select and incorporate thinking skills programs in their curricula? The evidence from the field includes an assortment of characteristics and implementation strategies that vary in specifics but remain consistent with the theories outlined in the first chapter. This chapter provides a national perspective on the extent of implementation of thinking skills programs, based on the outstanding report by the American Association of School Administrators (Pauker 1987).

In the report's preface, Pauker emphasizes the importance of thinking skills:

> Thinking is the basic of the basics...it is requisite for mastery of all subject-matter in the curriculum...and it is the essential skill for success in the 21st Century, when, not the acquisition of facts but their analysis and management, will be the key to national and personal survival and success. Thinking students are needed now and will be needed for generations to come.

The Perspective of School Administrators

To discover whether administrators also believe there is a need for thinking skills instruction and to assess the state of thinking skills programs around the country, AASA conducted a national survey (Pauker 1987) of school leaders. The results of the survey identified three convictions held by most respondents:

1. Instruction in thinking and reasoning skills is important for students and for the community.
2. It is feasible and practical for a district to install thinking skills

instructional programs.

3. Teaching of thinking skills must not be done "in isolation," but must be incorporated into subject-matter offerings.

The AASA questionnaire, completed and returned by 500 school administrators, placed all respondents in one of three stages—a wait and see stage, an exploration stage, and an active stage. Most school administrators pass through these stages as they introduce, develop, or maintain thinking skills programs in their schools.

Wait and See Stage

Some of the respondents who fall within this category expect teachers to provide the impetus for developing thinking skills programs. Others in this category intend to make thinking skills a priority in the district in the near future. Approximately 80 percent of respondents in the survey were placed in this category.

Exploration Stage

Respondents in this category are planning ahead before deciding on a thinking skills program. They are briefing themselves through discussions with their peers, attending seminars and workshops, and reading up on the subject. Among the comments made by those in this category are "We're encouraging teachers and staff members to study, experiment, and explore" and "We're encouraging curriculum directors to develop thinking skills units." About 15 percent of the survey respondents were placed in this category.

Active Stage

Respondents in this stage have started to implement a thinking skills program. The program is in the pilot stage or incorporated in selected classes. The respondents purchased a program from commercial sources or developed their own. One superintendent commented, "We're trying out no fewer than four different programs but aren't sure where we're going from there." Another respondent expressed certainty: "We're laying the basis for a long-range effort to conduct a locally-developed program." Although 89 percent of respondents answered, "Yes, very" to the question "Is instruction in thinking skills important?", only about 5 percent of the respondents had actually implemented thinking skills programs in their schools or districts.

How do the convictions held by school administrators in regard to thinking skills influence them in their decisions to purchase or develop a thinking skills program? To be more specific, which student skills do educators most want to strengthen through thinking skills programs? There are no ready answers applicable to all schools. However, the experience of schools and districts may throw some light on how to go about selecting a ready-

made program or designing one to meet school-specific needs.

The following section, again summarized from the AASA report (Pauker), traces the development and implementation of successful thinking skills programs in Pittsburgh and Baltimore. The evolution of programs in these districts may provide guidance and encouragement to administrators in the "wait and see" and "exploration" stages who are ready to more actively promote thinking skills in their districts.

The Examples of Pittsburgh and Baltimore

The experience of the Pittsburgh Public Schools can be of benefit to other school districts. Commenting on the skills students will need to prepare for the twenty-first century, Pittsburgh's Superintendent Richard Wallace, Jr. observed in an interview with Pauker,

> If young people are to cope effectively in the "information society" of the 21st century, they must be skilled at critical thinking and problem solving.... Simply put, students have not learned the critical thinking skills that would allow them to analyze textual material and then write a coherent statement where they use evidence from their reading to support their interpretations and judgments.

Some years ago, the district conducted an analysis of the effect of educational practice on thinking and problem-solving skills. The district came to three conclusions as a result of its examination of practice:

1. Although students learn to read a wide range of material, they develop few skills for critical examination of what they read.
2. While schools have been reasonably successful in teaching the majority of students to comprehend what they read at a basic level, they have failed to teach more than 10 percent of students to reflect and think critically about their reading.
3. Evidence from the field indicates an eclectic interest in carefully selecting the right one from the available thinking skills programs in the market or designing one that best fits the need of a particular school or school district. (Pauker 1987)

These conclusions spurred Pittsburgh to develop a thinking skills program that did two things. First, it systematically diagnosed students' thinking skills. Second, it developed instructional techniques that improved the way students were taught how to think.

The district assesses students' thinking skills with Monitoring Achievement in Pittsburgh (MAP) tests. As Pauker explains, MAP tests help teachers diagnose students' ability to "summarize, classify, and evaluate," requiring them to write an essay on a specific topic. The essays are evaluated for critical thinking skills using a predetermined list of criteria. The criteria include quality of construction of topic sentences, evidence, explanation,

conclusions, and logical organization.

Teachers administer and grade the tests. Then teachers and students together discuss critical thinking skills demonstrated in the essays. The discussion helps students to explore better ways to use their critical thinking skills. Students are given the opportunity to revise their papers after the discussion. A MAP essay test would be similar to the two samples illustrated below:

> *Directions: You have read the interview with James Otis. Now write a composition that contrasts the opinions of the interviewer and of James Otis on the use or misuse of search warrants. Your composition should include the following:*
>
> - A topic statement that tells how the two opinions differ
> - Evidence from the passage to support your topic statement
> - Explanations of how the evidence shows the differences of opinion
> - A concluding statement pulling together what you have written
>
> *Directions: You have read the article by Thomas Paine, and you have decided whether or not his arguments have convinced you to support the fight for independence from Britain. Now write a composition in which you explain your decision. Your composition should include the following:*
>
> - A topic statement telling whether or not you would support the fight for independence
> - Evidence from the article to support your main idea
> - Explanations of why the evidence supports your decision
> - A concluding statement pulling together what you have just written (Pauker 1987)

The Baltimore City Public Schools started their thinking skills program in 1983. In 1987, Charles R. Hancock, associate superintendent, explained the district's goals to Pauker:

> We have examined our school district's basic curriculum and identified an inherent focus on thinking skills. As we continue the process of infusing thinking skills in all curriculum areas during the coming years, we will be searching for ways to help both staff and students to MAKE CONNECTIONS between fact and their larger meanings as a natural part of the thinking process. Our experience has shown that this aim is achievable. (Pauker 1987)

A brief summary of Baltimore's experience is presented here, to serve as a guide for educators who want to establish their own thinking skills

programs. The Baltimore thinking skills program starts with four assumptions:

1. Improvement of students' thinking skills should result in increased student achievement.
2. All students need to develop higher levels of thinking.
3. Systematic teaching of thinking skills across disciplines and grade levels is necessary.
4. Infusion of thinking skills is a long-term effort with ongoing staff development as a key element. (Pauker 1987)

The Baltimore schools achieved these goals using four educational programs: *Philosophy for Children, Strategic Reasoning, Instrumental Enrichment,* and *Junior Great Books*.

Student progress is periodically evaluated as they work through the programs. The evaluation instrument draws from some of the assessment tools of the Scholastic Aptitude Test, the Cognitive Abilities Test, the California Achievement Test, and two teacher-designed instruments. For a sampling of the questions in the evaluation instrument, see Pauker (1987).

Conclusion

The AASA survey results indicate that the vast majority of administrators believe teaching students to think is one of the primary missions of schools. Most districts, however, according to Pauker,

> are proceeding with caution and with deliberate steps. The majority of school administrators are at a point where they are still asking questions about thinking instruction and searching for ways to develop programs which are uniquely their own and closely tied in with their districts' courses of study.

AASA's description of three basic stages in which administrators can be classified may help school leaders to assess where they are in relation to thinking skills. The programs highlighted above, and the programs in Oregon that are cited in chapter 4, provide administrators with a glimpse into how some of their colleagues have assumed a more active stance in regard to thinking skills. This, in turn, may help them to move toward making thinking skills instruction a reality rather than merely a goal.

Chapter 3

Thinking Skills Programs in the Schools

How well do the theories of thinking skills translate into practice? Do they help students to perform their school work? Do thinking skills have an impact on elementary and middle school students? This chapter attempts to answer these questions by assessing thinking skills programs in schools and school districts in Oregon. The experience of these schools indicates that thinking skills programs work well when they consistently follow clear and simple criteria for identifying specific thinking skills and for specifying ways to teach them. The following descriptions also highlight another key finding: effective programs incorporate both thinking techniques and substantive content in instruction.

Programs at selected elementary schools are described first, followed by those in middle schools.

Thinking Skills Programs in Elementary Schools

Economists, social scientists, and educators have long been aware of the importance of education in the formative years of the child (Charles Benson 1988 and Theodore Schultz 1981). Researchers have demonstrated that the gains made by children in the first few years of schooling are associated with their later success in high school, college, and the workplace. These gains, according to Benson, include the abilities to think creatively, reason critically, and solve problems.

Several major studies on rates of social and economic returns to education identify children's experience in elementary school as the most important factor in determining their performance in later life. In this context, "rates of return" indicate the income streams associated with the number of years of schooling. George Psacharopoulos (1985) conducted comparative

studies on rates of return to education in Latin America, Africa, and Asia. Regardless of the country or continent, he consistently discovered that the rates of return were highest at the elementary level. If the first few years of schooling are predictive of long-term performance of students, we should place strong emphasis on developing thinking skills at this level. The following section examines some thinking skills programs in Oregon elementary schools.

Banks School District

The Banks (Oregon) School District established its thinking skills programs in 1984. "About five years ago, we evaluated the thinking skills component in our curriculum. We found a lot of different thinking skills, but nothing really put together," said Charlene Harris, vice principal of Banks Elementary School. Harris admits to initial confusion in the design and implementation of the thinking skills program. "There was a lot of resistance from the teachers on this issue. The initial response was 'I teach thinking; what do you mean?' kind of thing," Harris said.

The key was to make the teachers aware that thinking skills should be integral to all coursework, not taught in isolation from the rest of the curriculum. This is consistent with the finding that thinking always involves thinking *about* something (Beyer 1984). Expressed another way, teaching thinking skills requires teaching subject content simultaneously.

Harris's view of thinking skills accurately reflects this finding as well as those of the Valley Educational Consortium, summarized at the beginning of this section. "We would like our children to be competent in a number of areas: fluency in the different subject areas; flexibility; and creativity," stated Harris.

The Banks School District was concerned enough about the issue of thinking skills to invite a specialist from the Institute of Creative Education based in Sewell, New Jersey, to offer a workshop on the topic. As a result of the workshop, a committee for thinking skills was formed. The committee, made up of local educators, designed a program called Goals-Options-Prioritization-Action (GOPA).

The GOPA program operates on the premise that diverse thinking skills can be developed in students by using problem-solving approaches to all learning. The approach calls for linking these problem-solving techniques to subject areas such as language arts, mathematics, science, and social studies. Students in the GOPA program meet once a week for forty-five minutes.

The program's format consists of a set of activities that vary according to the methods being used to generate new ideas. Each activity has an introduction by the teacher and a student motivation section. Problems are designed in such a way that no two students can give identical answers. The students are asked to solve problems within a specified amount of time.

Later, the students evaluate their own responses to assess their level of originality and flexibility, with the teacher acting as a guide. The informal, nonthreatening environment increases students' comfort with evaluating the quality of the thinking skills content in their work.

A sample language arts exercise in the GOPA program is presented in table 1. Note that the first key expands the range of questions the teacher can pose to the student. This serves two purposes. First, the teacher can focus or trigger the action verbs to describe the mental activity to the student, listed in the left column. Second, the student has the option of performing the activity or following the problem-solving sequence listed in the middle and right columns.

Table 1: Sample Exercise, GOPA Program, Banks School District

If you want to measure:	*Use these key words in the exercise:*		*Illustration*
Recall	define identify label list name repeat	what when who	List the names of the main characters in the story.
Analysis	subdivide breakdown separate categorize sort		Break the story down into different parts.
Comparison	compare contrast differentiate distinguish		Compare themes of these two stories.
Inference	deduce predict infer speculate anticipate what if...	apply conclude	How might we make this character more believable?
Evaluation	evaluate judge assess appraise defend critique	argue recommend debate why	Evaluate this story. Is it well written? Why or why not?

Source: Banks School District, 1986.

Student progress is partly assessed with the Torrance Test for Creative Thinking or the Williams Creativity Assessment Packet. Students are pre- and post-tested with these instruments. While some swear these tests have the ability to measure creativity, others argue that they do not. The potential problem of measuring creativity is related to the difficulty in defining it, as explained in chapter 1. The key point to remember is that these tests are only approximate indicators of thinking skills. Thinking skills are always context dependent, and contexts change with ability, home environment, and school environment.

The Banks School District compensates for this weakness in measurement by emphasizing the qualitative data on students, such as impressions and insights of parents, teachers, and peers. This permits student development in thinking skills to be assessed in relative terms at the end of the school year.

Troy Elementary School, Enterprise

Theodore Zeller, head teacher of Troy Elementary School in Enterprise, Oregon, strongly believes in thinking skills. Zeller uses a developmental software package, "System 80," and Apple III computers to teach thinking skills. "System 80" is a diagnostic instrument that permits teachers to diagnose, prescribe, and evaluate students using computers. The software package has builtin features for pre- and post-testing students on thinking skills and content.

Zeller infuses all class instruction with thinking skills, assisted by the computer-supported package. He employs a three-pronged approach to teaching thinking skills. First, he pretests his students to determine their level of thinking skills and knowledge in a given subject. Second, he presents the course material in lecture form. Third, he posttests the students to evaluate how well they have learned to think creatively and critically and how much content they have mastered. Students learn the subjects at their own speed, without pressure to conform to a statistically determined mean level of achievement. Zeller's approach agrees with Sternberg's (1988) triarchic theory of thinking, reported in chapter 1, which suggests that teaching style should be adapted to the individual student's learning style, and not the other way around.

Zeller uses the Apple computers to match his lectures to his students' needs. For example, in his English class, after presenting the subject content and the rules of grammar, he asks students to use the computer to do a set of matching exercises that test their knowledge of word contraction using the subject as context. After the posttest, each student receives individual attention from Zeller to focus on areas that are causing difficulty for the student. The tests reflect students' mastery of thinking skills and subject matter.

The highly interactive nature of computers makes for a stimulating teaching-learning environment, said Zeller. He uses the computer and the

"System 80" software package to infuse thinking skills into all of his courses.

Troy Elementary School purchased its computer system in 1988. Based on the evaluation conducted during the past year, Zeller contends students learn thinking skills and content matter better and faster with computers. One reason for this is the speed and ease with which students can interact with the medium of instruction to learn both thinking skills and subject context. This, in turn, stimulates students to apply their thinking skills to the course material without fear of disapproval from their teacher. Again, we see the interconnectedness between thinking skills and subject matter.

Nyssa Junior High School

Nyssa (Oregon) Junior High School includes both the elementary and middle school grades. Peggy Farmer, a third-grade teacher at Nyssa, is convinced the key to fostering excellence in schools lies in developing thinking skills. She defines these skills as a form of "integrated questioning with reference to reading, science, and brainstorming."

Nyssa uses the "Onward to Excellence" program, which attempts to improve students' thinking skills and mastery of subject matter over a two-year period. About five hundred schools throughout the nation participate in this program. The program focuses on brainstorming, reading, and science. The brainstorming and reading components promote creative thinking techniques while the science components improve critical thinking techniques.

The program considers thinking techniques and content to be tightly enmeshed and inseparable. Because thinking is taught alongside content instruction, the process is termed *infusion*. With infusion, thinking skills are never isolated from content instruction. The advantages of an infusion approach are fourfold. First, students are thinking about thinking while mastering subject matter. Second, a separate thinking skills program is not necessary. Third, infusion makes clear to the student that thinking about school work is not different from thinking about real life. And fourth, thinking about thinking is an effective method to master both thinking and content. This encourages students both to learn more and learn more effectively. In his book *Action Science: Concepts, Methods, and Skills for Research Intervention,* Chris Argyris (1985) and his colleagues refer to context dependent learning as "double-loop learning" because students learn content and simultaneously learn to think more effectively and more quickly than they would have if content and process were taught in isolation.

"One technique we commonly use in our program is mapping," Farmer states. Mapping can be applied to all three areas—brainstorming, reading, and science. Farmer explained this principle using reading as an example: "In reading, mapping takes the central issue under discussion and connects it to its ramifying ideas." Again, we note the connection between content ("the central issue") and thinking skills ("ramifying ideas"). Farmer notes that students in the third, fourth, and fifth grades respond well to the

techniques for teaching thinking skills. For example, students do particularly well diagramming decision trees at these grade levels. "It's when you start working with the students in the first and second grades that it gets a little hard," states Farmer.

Farmer's experience with teaching thinking skills is consistent with the finding that student mastery of thinking skills depends on how much content matter they know, as mentioned in chapter 1 (Beyer 1984). Thinking skills can be more easily developed in third- through fifth-grade students than in first- and second-graders because the older students have had more time to master more content matter.

Ione Junior High School

"We want our students to be self-directed and be able to solve problems in a real-life context" responds Dick Allen when asked about his reason for infusing thinking skills in the curriculum of Ione (Oregon) Junior High School. Allen, principal of the K-12 school, encourages teachers to infuse all their courses with thinking skills. He maintains a comprehensive view of the quality of thinking skills imparted in instruction through his weekly assessment of the teachers' lesson plans.

Allen is supportive of the teachers and does not subscribe to the view that student performance on standardized tests is the only indicator of teacher effectiveness. "Student performance is *one* of the many indicators of teacher effectiveness," he firmly insists.

Allen gives teachers at Ione a free hand in being creative in their coursework without being limited to the prescribed textbooks. Too often, teachers think they are bound to the prescribed textbooks because of emphasis placed on them in the standardized tests, he said. As a result, the standardized tests to some extent drive the school texts. The consequence of this can be that students merely learn techniques to help them to perform well on standardized tests. These techniques may not include all the components of thinking skills. To dispel the perceptions that student performance on standardized tests reflects students' mastery of thinking skills and instructors' teaching ability, Allen meets with teachers on a daily basis to exchange ideas on effective teaching.

As part of Allen's plan to promote effective teaching of thinking skills, the school recently established two computer laboratories. One is equipped with Apple and the other with IBM computers. Software for the social studies and health curricula has been purchased, and Allen hopes to have all the computers eventually hooked up to a number of educational networks. Allen is studying the feasibility of purchasing a number of portable inscripted databases, popularly known as CD ROMs, which would give students access to a rich source of educational databases and other course-related materials.

Dick Allen's enthusiasm for computers in education ties in well with both the current research on cognitive processing skills and thinking skills (Victor Willson 1989). Willson's work highlights the key finding that

academic ability is tied to the student's ability to take facts and convert them into information and then into knowledge. Expressed another way, it is not enough just to "know" facts in isolation. More important is the ability to select the right facts and then correctly apply them. Using the computer, students quickly "know" facts, pick the right ones, and then appropriately apply them. Both thinking techniques and content matter are quickly taught using the highly interactive and responsive nature of the computer.

South Sherman Elementary School, Grass Valley

Latrelle Smoot emphasizes thinking skills through an enrichment program. He is the principal of South Sherman Elementary School in Grass Valley, Oregon, as well as the superintendent of the South Sherman School District. Smoot integrates thinking skills in math, reading, and writing. "It's a difficult subject to get a handle on. We want our students to go beyond simply regurgitating facts. We would prefer that our students learn to think analytically and critically."

He encourages the students to participate in the enrichment program by individualizing problems to meet the needs of each student and by offering "extra credit for extra work." The program is open to all students. Students earn extra credit by mastering one to five extra spelling lists, solving a number of mathematical problems, and generally being accountable for a number of duties that require additional academic work.

The math component of the program helps students develop their problem-solving skills. Critical thinking skills are met through the reading component of the program. Finally, the writing component of the enrichment program encourages students to improve their creative thinking skills.

Teachers adapt their instructional styles to the different thinking styles of their students, as opposed to requiring students to adapt their learning styles to the teaching styles of their teachers. The coursework is individually tailored to best meet the special needs of the students. The program has taken to heart Sternberg's (1988) belief that teachers must be ever mindful of the different and special needs of their students, not only to help them but also to avoid harming them:

> It is conceivable that a student who prefers following his or her own rules in assignments may actually tend to come up with more creative solutions, and that this, in turn, may be punished by a strongly executive teacher who wants things done by the rule. It seems reasonable to conclude that the teacher can actually come to believe that the student is not "intelligent," since the student "does not seem to be able to follow rules," and that the teacher's conception of the student as not being intelligent may affect the student's own conception of his or her intellectual abilities, perhaps even making the student doubt his or her abilities. Thus, it seems that the fit between teaching style and the student's intellectual profile can be of critical importance to the success of the teacher-student system.

Thinking Skills Programs in Middle Schools

The interdependence between thinking skills and content is one common thread running through the various definitions of thinking skills suggested by Sternberg and others. This interdependence increases with age, as reflected in Peggy Farmer's observation that students in the third, fourth, and fifth grades respond well to the techniques for teaching thinking skills. Her students in the higher-grade levels can perform better on exercises that require some abstract thinking, such as diagramming decision trees, because they have mastered more content than younger students.

Although education plays its most important role at the elementary school level, Farmer's experience with teaching thinking skills shows that at the middle-school level that role can be expanded. In their early years of schooling, students begin their formal introduction to the different types of thinking—including serial, sequential, and spatial thought. And then, during their middle-school years, as they gain mastery of more content matter, they significantly develop and build on those types of thinking. Because students make significant gains in consolidating and augmenting their thinking skills during their middle-school years, teachers and administrators should continue to infuse thinking skills into the curriculum during this important period.

Pendleton Junior High School

Karolyn McMillan of Pendleton (Oregon) Junior High School is a firm believer in thinking skills. "I hope to help my students learn to think. It certainly is better to help students learn how to think than to help them regurgitate text material," she declared.

The staff at Pendleton agreed on the need for a thinking skills program about three years ago, said McMillan, who teaches geography and world history to seventh- and eighth-grade students. "We are in the process of actually putting it together," she added. The school divided the task of constructing the program. The social studies department is writing the questions to develop creative thinking skills, and the English department is responsible for constructing the questions that will test and develop the critical thinking abilities.

Overall, a set of eleven questions will indicate and enhance students' thinking skills. The questions are aimed at helping students to answer in a consistent, logical fashion. They will focus on determining how students arrive at solutions to unfamiliar problems rather than measuring what students can recall of a given body of material.

The questions will be designed in such a way as to concentrate on improving both techniques of thinking and mastery of subject content. The questions will seek to identify and develop the students' mental techniques used to solve problems. Real-life examples in the questionnaire will emphasize content matter as necessary to teach and learn thinking skills. The school's guidelines follow Perkins's (1984) and Nickerson's (1984) sugges-

tion that all thinking skills programs should incorporate problem-solving skills and decision-making skills. Combining both sets of skills in the questionnaire can guarantee thinking skills and content matter are taught.

Daly Middle School, Lakeview

Gerald Prickett implements thinking skills instruction through the Talented and Gifted (TAG) program in Lakeview, Oregon. "Kids have a good time, and they learn quite a bit in the program," explains Prickett, principal of Daly Middle School. The afterschool program emphasizes math skills and is open to all students. Other emphasized skills are creativity, problem-solving, and the three R's—reading, writing, and arithmetic.

The TAG program uses "Pent-a-Games" to develop math skills and critical thinking skills such as recall, analysis, comprehension, and inference. "Odyssey of the Mind" focuses on creative problem-solving. Used in combination, the two educational packages meet the twin purposes of teaching thinking skills, as suggested by Stiggins and his colleagues (1989): (1) solving problems and decision-making and (2) creating ideas and knowledge that did not exist before.

The TAG program has now been operating for five to six years, three days a week. Feedback has been positive, though the value of the program cannot easily be captured by standard measurement instruments. "The feedback and evaluation process is informal because it is not a real formal program," Pritchett explained. Student and parent support for the program is strong.

Students in the TAG program are high achievers and highly motivated. The opportunity to go on field trips to other schools to compete in contests that test their math skills provides added incentives to students who join the TAG program. The school and the community strongly support these academic endeavors. The TAG students' hard work and accomplishment are recognized in articles in the school newspaper and the community newspaper.

The Talented and Gifted program has both academic and practical value, said Prickett. Students apply their newly acquired abstract skills to real-life situations. For instance, students use these skills when they use computers to produce the school paper and manage accounts. The TAG program competes well with other interests, such as sports and part-time work, which indicates thinking skills are a priority at Daly Middle School.

Azalea Middle School, Brookings

Jim Mercer, principal of Azalea Middle School in Brookings, Oregon, initiated a thinking skills program this school year. The nine-week program calls for mastery of the academic coursework in language arts, math, and arts and sciences and then their testing and application in field settings. Mercer underlines the importance of creative and critical thinking skills in all

content areas.

The thinking skills program was developed after Mercer visited a number of other schools in Oregon. The program, designed to bridge the academic knowledge of school with the ordinary knowledge of everyday life, incorporates some of the elements of "Odyssey of the Mind," a collection of educational strategies that emphasize learning by doing. These strategies reinforce and enhance the students' thinking skills. One example is the method for directly introducing students in English and social studies to great literary works by having them read and analyze the writings of Shakespeare, Wordsworth, and Longfellow, and reinforcing this experience with visits to the Shakespearean Festival in Ashland, Oregon.

A second example is to have students in the science class conduct laboratory experiments in school and verify their results through field trips. Both examples integrate thinking and thinking about thinking, as suggested by Nickerson (1984). Techniques of critical and creative thinking are jointly taught with substantive content. Students' thinking skills are then further reinforced with the field trips.

Mercer hopes to significantly increase the number of students enrolled in the program by 1990. He is in the process of creating a position aimed at strengthening the program to support the anticipated increase in students. This program will eventually be incorporated into the school's Talented and Gifted program, which is still in the planning stage.

Mercer is considering how best to evaluate the program, and he is hesitant about stressing any one evaluation technique. This position is understandable because the complexity of thinking skills does not lend itself easily to any one particular measurement technique. At the end of the school year, he hopes to release a questionnaire to the students and their parents through the school paper requesting their feedback on the program.

Mercer said he would take a look at some of the elements of the standardized tests issued by the Oregon State Department of Education and other standardized tests including the California Achievement Test and the Stanford-Binet Test. The standardized tests are only one set of guidelines, he explains. Many other sets of guidelines, perhaps more important ones, need to be promoted and brought to bear on the assessment of thinking skills.

Conclusion

Debate over what thinking skills are and how to improve them continues even as schools tackle the issue and demonstrate productive ways of enhancing student thinking. The accounts of the programs in this chapter note a consistent measure of success as gauged by those who implement and evaluate them. They underscore the salience of combining thinking skills and substantive content in program implementation.

We need not wait for research to arrive at a precise definition of

thinking skills before we start designing a thinking skills program or selecting one from the available educational packages. No doubt, new research will continue to refine our unfolding understanding of thinking skills, but current research is sufficient to begin a program.

Schools' ability to develop effective thinking skills programs, despite the fact that research has not precisely defined all components of thinking skills, becomes especially important when one considers that 80 percent of school administrators are at the "wait and see stage" and 15 percent are at the "exploration stage" (Pauker 1987) in regard to thinking skills. The proof of the pie is in the eating. Let us begin.

Chapter 4

Commercial Programs That Integrate Thinking Skills

Robert Sternberg (1984), a professor of psychology at Yale University and a noted authority on thinking skills, reviewed two ready-made thinking skills programs in "How Can We Teach Intelligence?," an article that appeared in *Educational Leadership*.

This chapter summarizes Sternberg's reviews because of his expertise in this area. Also, a report on Stanley Pogrow's (1990) Higher Order Thinking Skills (HOTS) program is included. These programs receive additional support as Rex Jackson (1985) concludes that the teaching of mathematics and expository reading and writing skills can be two effective ways to develop students' thinking skills. All three programs are suitable for students drawn from both the majority cultures as well as from different socioeconomic groups.

One of the programs Sternberg reviews focuses on critical thinking skills stressing mathematics, and the other features critical reading and comprehension, focusing on creative thinking skills. The HOTS program concentrates on helping students to make logical inferences so that they can better grasp problems. Taken together, they can help students master the three "R"s: reading, writing, and arithmetic.

Instrumental Enrichment Program

Reuven Feurstein's (1980) training program *Instrumental Enrichment* can help students learn both creative and critical thinking skills, although, with its focus on math, it emphasizes critical thinking skills. According to Sternberg, this program has practical application when students exhibit these signs:

1. Unplanned, impulsive, and unsystematic exploratory behavior.

When presented with a number of cues to problem solving that must be scanned, the individual's approach is disorganized, leaving the individual unable to select those cues whose specific attributes make them relevant for a proper solution at hand.

2. Lack of or impaired capacity for considering two sources of information at once, reflected in dealing with data in a piecemeal fashion rather than as a unit of organized facts.
3. Inadequacy in experiencing the existence of an actual problem and subsequently in defining it.
4. Lack of spontaneous comparative behavior or limitation of its appearance to a restricted field of needs.
5. Lack of or impaired strategies for hypothesis testing.
6. Lack of orientation toward the need for logical evidence.
7. Lack of or impaired planning behavior.

The *Instrumental Enrichment* program has thirteen different types of exercises. These exercises are designed to be repeated in cycles throughout the duration of the program. Some of the exercises are described by Sternberg:

1. *Orientation of dots*. The student is presented with an amorphous two-dimensional array of dots. The student's task is to identify and outline, within this array of dots, a set of geometric figures, such as squares, triangles, diamonds, and stars. The student might see at the left a picture of a square and a triangle, with the triangle situated to the bottom right of the square. The student would have to use the dots to draw a square with a triangle below and to the right of the square.
2. *Comparisons*. In one form of comparison exercise, the student is shown a picture at the left; for example, two small apples that have no internal shading or coloring. In one picture, the student might see a single apple, larger than the ones at the left, and fully shaded inside. In the other picture, the student might see three apples rotated to an upside-down position that are also larger in size than two apples at the left. The student's task is to indicate, in each picture, which of the attributes of direction, number, color, form, and size differ between the picture at the left and each of the pictures at the right.
3. *Temporal relations*. In one problem of this type, the student is confronted with pairs of temporal durations, such as "one year" and "11 months" or "a quarter of a year" and "four months." The student is asked to indicate whether the first duration is greater than, equal to, or less than the second duration.
4. *Numerical progressions*. In one kind of numerical progression problem, the student is given the first number in a sequence and a rule by which the sequence can be continued, for example, +3, -1.

The student then has to generate the continuation of the sequence.

Instrumental Enrichment has both strengths and weaknesses, as is true of most training programs designed to improve thinking skills. On the whole, however, the strengths outnumber the shortcomings. Sternberg identifies the strengths as follows:

1. It can be used for children in a wide age range (from the upper grades of elementary school to early high school) and for children of a wide range of ability levels and socioeconomic groups.
2. It is attractive to children and appears to be effective in raising their intrinsic motivation and self-esteem.
3. It is well packaged and readily obtainable.
4. It appears effective in raising children's scores on ability tests. Indeed, most of the training exercises contain items similar or identical to those found on intelligence and multiple aptitude tests, so that it should not be totally surprising that intensive practice and training on such items should raise these test scores.

In turn, Sternberg identifies these shortcomings:

1. The program requires extensive teacher training, which must be administered by a designated training authority for the duration of the program.
2. The isolation of the problems from any working knowledge or discipline base (such as social studies or reading, for example) raises questions regarding the transferability of the skills to academic and real-world intellectual tasks, especially over the long run.
3. In spite of the program designer's aversion to IQ tests, the program trains primarily those abilities that IQ tests tap rather than a broader spectrum of abilities that go beyond intelligence as the tests test it.

Chicago Mastery Learning Reading Program

Beau Jones's (1982) *Chicago Mastery Learning Reading Program* emphasizes learning strategies and study skills. Learning strategies emphasize subject context more than thinking techniques. The program is divided into several parts that include student activities, optional teaching activities, formative tests, additional activities, enrichment activities, retests, and subject-related applications. Sternberg summarizes the Chicago program as follows:

1. *Using sentence context.* In one type of exercise, students read a sentence containing a new word for them to learn. They are assisted in using cues in the sentence to help them determine the

word's meaning.

2. *Mood in reading and writing*. Students are given a sentence from either expository or fictional text. They are asked to choose which of the three words or phrases best describes the mood conveyed by the sentence.
3. *Comprehending comparisons*. Students are taught about different kinds of comparisons. They are then given some sample comparisons and asked to elaborate on the meanings, some of which are metaphorical.
4. *Facts and opinions*. Students are taught how to distinguish facts from opinions. They are given a passage to read, along with some statements following the passage. Their task is to indicate which statements represent facts and which opinions.

Strengths of the *Chicago Mastery Learning Reading Program*, according to Sternberg, are as follows:

1. Its applicability to students drawn from all intellectual and socioeconomic levels.
2. The relatively short amount of time required for teacher training.
3. Its ease of incorporation into existing curricula.
4. The immediate applicability of the skills to school and other real-life situations. Evaluations of students reveal significant pretest and posttest gains from the program.

The limitations of this program are likewise enumerated by Sternberg:

1. The program materials may not be intrinsically attractive to the students.
2. The skills trained by the program may be limited to reading and verbal comprehension.
3. The program is not clearly grounded in a psychological theory of cognition.

The HOTS Program

Stanley Pogrow's (1989) HOTS program is designed to help at-risk students grasp problems in their entirety and make logical inferences from the presented problems to solve them. The program combines the use of Apple II computers with the questioning approach of teaching, also known as the Socratic teaching style. The following four thinking techniques are strengthened with the use of HOTS (Pogrow 1989):

- *Metacognition:* consciously applying strategies to solve problems
- *Inference from context:* figuring out unknown words and information from the surrounding information

- *Decontextualization:* Generalizing ideas from one context to another
- *Synthesis of information:* Combining information from a variety of sources and identifying the key pieces of information needed to solve a problem

Both average and at-risk students increase their academic performance using these four techniques. The National Diffusion Network confirmed that HOTS contributed to students' assessed abilities, which were significantly higher than the national average for reading and math. Gains in reading and math were, respectively, 67 percent and 123 percent higher than the national average (Pogrow 1990). At-risk students' achievement significantly improved after using HOTS. For example, 36 percent of Chapter 1 students made the honor roll in Mary Dill Elementary School in Altar Valley, Arizona, after participating in the program. Two of the top four academic achievers of Doran Annex Elementary School in Fall River, Massachusetts, were Chapter 1 students. Both had used HOTS (Pogrow 1990).

Conclusion

These brief reviews of three packaged programs suggest that thinking skills can be improved by proper intervention and training. This suggestion has two encouraging implications for student performance. First, thinking skills programs can play a significant role in enhancing student performance and thereby reversing the documented trend of inadequate academic achievement (Stiggins and others 1989). And second, we will serve the needs of our students better by developing their cognitive abilities than by testing them.

Chapter 5

Criteria for Designing and Selecting Thinking Skills Programs

"Look before you leap" and "He who hesitates is lost" are two contradictory sayings that illustrate the educator's predicament as he or she works through the problem of designing a thinking skills program.

Developing a Program

Beyer's work (1984) suggests it may be more beneficial for educators to develop their own thinking skills program than to purchase one because (1) some of the programs are so well designed that they practically think for themselves, absolving teachers from thinking and teaching thinking skills; and (2) some of the programs, because they are aimed at a general nationwide market, can operate context-free, disconnected from the subject matter.

To avoid these problems, educators can elect to design their own program. Presented below are some questions to consider when contemplating a thinking skills program:

- Are teachers and curriculum workers ready and willing to discuss the acquisition of a thinking skills program?
- Does the board of education understand the rationale for introducing thinking skills into the curriculum?
- Has a board policy on thinking skills been thoroughly discussed by teachers, administrators, and the public and approved by the board?
- What particular thinking skills does the district believe to be of

first importance to teach?

- What financial resources does the district have for (1) carrying on preliminary investigations and hiring consultants to advise on steps and procedures; and (2) outlays to purchase a program, its products, and services?
- Does the district plan to experiment with limited approaches and with a pilot program?

If a commercial program is going to be used, Sternberg (1984) suggests that "clearly the decision on which program to use should be made only after extensive deliberation and outside consultation, perferably with people who have expertise but not a vested interest in the implementation of one particular program or another."

Selecting a Program

Clear criteria will help teachers and administrators who wish to select a training program that infuses thinking skills in the curriculum. First, the program should be based on a clear psychological theory that defines *which* thinking skills—creative or critical—are taught and a clear educational theory that stipulates *how* these thinking skills are taught.

Second, the training program should address the resultant differences in student ability brought about by culture and socioeconomic status. Third, the selected program should have an empirically demonstrated track record of success.

Fourth, the program must make explicit the connection between specific thinking skills and their use in performing tasks. This point needs to be stressed: It is not enough for students to "know" the different types of thinking skills isolated from their substantive contexts. Effective mastery of thinking skills dictates students understand the relationships between thinking skills and subject matter. Research and field experience both indicate students master thinking skills only after they learn to apply the techniques to new situations. Fifth, the program should be strongly associated with educational institutions reputed for their rigorously tested curriculum for teacher training and for student training.

Another criteria to consider is the kind and quality of training that will be provided for teachers. Do the packaged materials contain all that teachers need to know to teach the program, or must inservice sessions be scheduled?

Whether the district is designing its own program or purchasing a commercial package, it is wise to keep the program clear and simple, at least at the beginning. Once established, the programs can be refined and adapted to meet the specific needs of each school.

Conclusion

This Bulletin has reviewed research on and definitions of thinking skils. It then looked at educators' efforts to come to grips with this complex issue. Research and experience lead to the conclusion that, due to their complexity, thinking skills are not easily amenable to definition and measurement using standard pedagogical tools and techniques. The *multidimensionality* involved in the teaching of thinking skills and the *unidimensionality* entailed in defining and measuring them through standardized tests run counter to one another.

Standardized tests can be based on the notion of thinking skills as a quantity that can be captured in a static outcome. This notion leads to a decontextualized definition of thinking skills. Problems presented in textbooks can sometimes tap into this definition. As a result, students can erroneously categorize thinking into "textbook thinking" and "real-life thinking." Mental techniques are isolated from their substantive contexts in this kind of categorization. Because of this isolation, students' thinking skills can remain inert even when they attempt to apply these skills. The textbook problems can be part of this difficulty. Problems presented in textbooks may be remote from students' real-world problems.

Students approach, solve, and forget textbook problems after they are presented. However, students may find that they cannot similarly solve real-world problems, which can be ill-structured, messy, and persistent because they are always contextualized.

Students can learn to apply their thinking skills in the real world if textbook problems sufficiently resemble real-world problems; that is, textbook problems should be contextualized. The findings of both research and experience in teaching thinking skills drive home this point: problems are always contextualized in real life. Problems are solved within a frame of reference that explicitly accommodates the interrelationships between them. They are not solved in isolation from each other.

The programs reported in this Bulletin verify these interrelationships between mental techniques and substantive content in teaching students effective thinking skills. Also, the programs tell us that the current research is

adequate to design and implement thinking skills programs. This finding can be helpful to the 80 percent of superintendents, surveyed by the American Association of School Administrators, who are waiting to see how thinking skills programs implemented in other districts affect academic performance before deciding to implement their own program.

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